

REMARKS

I. Claim Rejections Under 35 U.S.C. § 102 (b)

The Examiner rejected claims 1 – 11 under 35 U.S.C. § 102 (b) as being anticipated by U.S. Patent No. 5, 599,096 to Rog (Rog). Further, claims 9 and 10 are rejected under U.S. Patent No. 3,846,058 to Counciller (Counciller). Applicant respectfully traverses these rejections.

In order for a rejection under 35 U.S.C. § 102(b) to be proper, all claim limitations must be shown by a single reference. Rog fails to teach “a generally conical surface for . . . maintaining working engagement with said extrudate to maintain pressure on said extrudate at said discharge end. (emphasis added).

As shown in Figure 1 of the present invention, the barrel has a diameter D1, which is constant until it reaches the discharge end, at which point it converges, i.e. decreases. With reference to Figure 1 of Rog, the barrel has a first diameter, then increases to a second diameter when it reaches the “screw nose.” The diameter of the barrel at the discharge end of Rog increases a third time.

It is well known that pressure is a function of area: $\text{Pressure} = \text{force}/\text{area}$. As shown by the present equation, pressure is inversely proportional to area, such that if the area increases, pressure decreases and if the area decreases, pressure increases.

With reference to claim 1, the present invention maintains pressure on the extrudate at the discharge end. To maintain the proper amount of pressure on the extrudate, the diameter of the barrel must remain constant and then converge towards the discharge end of the barrel. Attached as Exhibit A is Figure 1 of Rog. As shown, diameters B and C are larger than diameter A. As such, the pressure on the extrudate in Rog decreases, resulting in bubbles in the extrudate. Based

The extruder screw of this invention and method of extruding a shaped visco-elastic component are especially directed to the extrusion of visco-elastic materials such as rubber. As stated in the description, page 1, lines 7 – 23, porosity or the formation of bubbles at the discharge end of an extruder is a serious problem because the resulting extruded material is porous. In the description of the apparatus embodying this invention on page 3, lines 29 – 32, and page 4, lines 1 – 12, the unique extruder screw nose 26 and cylinder barrel 20 configuration is set forth with the method of maintaining pressure on the rubber to prevent formation of bubbles.

The prior art of U. S. Patent 5,599,096 of Rog is for “synthetic resinous materials” and also includes food products, waste products, and the like. There is no reference to the problem of extruding visco-elastomeric materials such as rubber, which have unique properties which are accommodated by the method and apparatus of the present invention but are not addressed by the prior art.

In the patent of Rog there is shown and described an extruder with an axially movable screw having a head portion 12 with a chamber defined by internal surfaces 38, 40, 42, and 44 as shown in Fig. 2. The screw 24 has a disc component 26 affixed to the forward end of the screw which is of increased diameter and which is positioned in the chamber. This disc component 26 has a frusto conical section 30 which provides a transition between the screw component 24 and the more outwardly disposed disc section 32. There is no teaching or showing of providing an extruder screw nose with “a generally conical surface for decreasing a transition space between said screw nose and said cylindrical barrel” as set forth in amended claim 1. Nor is there a disclosure of an extruder screw nose at the discharge end of a screw rotatable in a cylindrical barrel and having “an upstream portion of increasing diameter in the direction of flow of said extrudate” in accordance with amended claim 1. For this reason it is believed that claim 1 clearly distinguishes over Rog and reconsideration and allowance is respectfully requested.

With respect to claim 2, Rog does not show the screw nose on a screw in a cylindrical barrel with a converging tapered wall. Contrary to this teaching Rog has an enlarged chamber at the end of the extruder for containing an enlarged end of the screw. There is no cylindrical barrel for the screw “providing a generally conical surface generally parallel to a converging tapered wall of an adjacent flow channel block” as set forth in amended claim 2. It is submitted that this construction provides an entirely different treatment of the extrudate from that extruded by Rog. For this reason claim 2 as amended is believed to be in condition for allowance and such action is respectfully requested.

Claim 3 which is also dependent on claim 1 is directed to the feature of providing an upstream portion of the screw nose having a conical surface in the cylindrical barrel and not in an enlarged chamber of a head portion. This claim is believed to be allowable for this reason and for substantially the same reasons set forth above for claim 1.

Claims 4, 5, and 6 which are dependent on claims 2, 3, and 5 further define the specific angles of the conical surface of the extruder which is set forth in claims 2, 3, and 5. It is submitted that since the screw nose construction of this invention is for a totally different and

unique design that the dimensions of the disc component and chamber of Rog cannot teach or show the dimensions of the screw nose of this invention. Accordingly claims 4, 5, and 6 are believed to be allowable and such action is respectfully requested.

Claim 7 is directed to the method of extruding a visco-elastic material wherein the screw nose has an upstream portion of increasing diameter in the direction of flow of said material to a diameter not greater than the diameter of the cylindrical extruder barrel providing an upstream generally cylindrical surface. In Rog, page 3, lines 8 – 12, it is specified that the conical surface 40 increases in diameter in the direction of flow of said material to a diameter greater than the diameter of said cylindrical extruder barrel. Accordingly there cannot be the same working engagement as set forth in claim 7 for “confining the flow of said visco-elastic material through a transition space between a screw nose on said screw and said cylindrical extruder barrel.” It is respectfully submitted that where the diameter of the barrel is increased as in Rog the working engagement between the screw and barrel is not the same as that set forth in claim 7. Reference is made to the definition of “cylindrical” from *Webster’s Collegiate Dictionary*, 10th Edition, “the surface traced by a straight line moving parallel to a fixed straight line and intersecting a fixed planer closed curve.” This cylindrical configuration is essential for the operation of the claimed method in claim 7. Accordingly, reconsideration and allowance is respectfully requested.

Claim 8 which is dependent on claim 7 further sets forth the method of extruding the visco-elastic material from the upstream portion to the downstream portion of decreasing diameter in said transition space and conveying the material in working engagement under pressure with said downstream portion of said screw nose to prevent the formation of bubbles in the material. Claim 8 is believed to be allowable for this reason and for substantially the same reasons set forth above for claim 7.

Claim 9 which is directed to the extruder and flow channel head assembly sets forth the unique assembly of this invention wherein the extruder has “a cylindrical barrel” and a screw nose “having a radially expanding upstream portion providing a conical surface of increasing diameter in the direction of flow of said rubber for maintaining said rubber in working engagement with said screw nose and said cylinder wall, whereby the pressure on said rubber is maintained in said transition space.” Here again, the desirable “working engagement” with the rubber material is maintained between the “screw nose and said cylinder wall.” This clearly distinguishes over the prior art and reconsideration and allowance is respectfully requested.

Claim 10 which is dependent on claim 9 defines the downstream portion of the screw nose and its relation to the tapered wall of the flow channel head to maintain the working engagement of the rubber with the screw nose and with the cylinder wall “whereby the pressure on said rubber is maintained in said transition space.” Claim 10 is believed to be allowable for this reason and for substantially the same reasons set forth above for claim 9.

Claim 11 which is dependent on claim 10 is directed to providing a flow channel of constant cross section to maintain pressure on the rubber. In Rog the operating member or screw is movable axially of the extruder depending upon the change in viscosity of the material. Also by reducing the size of the outlet opening the back pressure can be increased to increase the temperature of the material. This is contrary to the teaching of the present invention where the extrusion of the rubber is provided under a controlled pressure to prevent formation of bubbles in the material. This requires a method and apparatus where the working of the rubber is provided without causing excessive pressures and high temperatures not acceptable in the extrusion of rubber. Claim 11 is believed to be allowable over Rog for these reasons and for substantially the same reasons set forth above for claim 10.

With reference to the patent of Counciller, et al. (U. S. Patent No. 3,846,058) which shows an injection molding apparatus where the screw is reciprocated to inject a thermoplastic material into a mold it is respectfully submitted that this does not teach the method of claims 9 and 10. In Counciller, et al. the screw is mounted for reciprocation between forward and rearward positions for injecting the rubber into a mold cavity. In column 4, lines 27 – 35, it is stated “the extruder screw 30 includes a helical flighting and on the forward end thereof a conical tip or smear head 32 is provided which cooperates with an extruder nozzle assembly 34 for directing plasticized rubber from the bore 28 through runners 36 to the mold cavity 22. A check ring 35 is positioned within the rear portion of the smear head 32 whereby backflow of a shot along the screw flights is prevented during injection.” Accordingly Counciller does not teach or show the invention as set forth in claims 9 and 10.

Claim 11 which is dependent on claim 10 further sets forth the feature of the flow channel for carrying rubber from said extruder to a suitable die having a generally constant cross-sectional area -- to maintain pressure on said rubber and provide time for volatiles in said material to be dissolved before ejection. In Rog as shown in Fig. 1 and described in column 4, lines 19 – 43, there is no teaching or showing of the flow channel having a generally constant cross-sectional area as set forth in claim 11. This is desirable to “maintain pressure on said

rubber and provide time for volatiles in said material to be dissolved before ejection from said flow channel head." Claim 11 is believed to be allowable for this reason and for substantially the same reasons as set forth above in claim 10.

Claim 12 has been added to more distinctly claim the present invention. More specifically it claims that "said upstream portion of said barrel of said extruder has a diameter D1 and said downstream portion of said barrel of said extruder has a diameter D2, wherein D2 is less than or equal to D1 to maintain pressure on the extrudate." As stated, Rog does not teach or suggest this claim limitation since the diameter of the downstream portion of the barrel is greater than the upstream portion of the barrel. Applicant respectfully contends that this claim is in condition for allowance.

VI. Conclusion

In response to the Office Action dated September 15, 2003, claims 1 and 2 have been amended and claim 12 has been added. It is believed this amendment has placed the amended claims in conformance with the requirements of the Office Action. At this point, applicant believes that the claims remaining in the case distinguish over the art cited and comply with the requirements of 35 U.S.C. §102 (b). As such, allowance of the claims is respectfully requested.

Respectfully submitted,

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Date January 13, 2004

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